IN THE UNITED STATES PATENT
AND TRADEMARK OFFICE

In re Patent Application of

McNIE | Atty. Ref.: 124-847

Serial No. 09/786,813 | Group: 1763

Filed: March 9, 2001 | Examiner: K. Moore

For: IMPROVEMENTS RELATING TO MICRO-MACHINING

Before the Board of Patent Appeals and Interferences

BRIEF FOR APPELLANT

On Appeal From Final Rejection
from Group Art 1763
Qinetiq Limited

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October 28, 2003

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Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

APPEAL BRIEF

Sir:

This is an appeal of the Final Rejection of March 27, 2003.[1]

REAL PARTY IN INTEREST

The real party in interest is the assignee Qinetiq Limited.

RELATED APPEALS AND INTERFERENCES

There are no interferences or other appeals related to this subject application

STATUS OF CLAIMS

Claims 1-23 are pending. Claims 1-9, 13, 16-20 and 23 stand rejected under 35 U.S.C. §103 as being unpatentable over U.S. Patent No. 5,427,975 to Sparks et al. in view of U.S. Patent No. 5,364,497 to Chau et al. Claims 9-11 stand rejected under 35 U.S.C. §103 as being unpatentable over Sparks and Chau, and further in view of U.S.

[1] The claims on appeal appear in Appendix A accompanying this brief.

Patent No. 5,620,933 to James et al. Claim 12 stands rejected under 35 U.S.C. §103 as being unpatentable over Sparks and Chau, and further in view U.S. Patent No. 5,798,283 to Montague et al. Claim 14 stands rejected under 35 U.S.C. §103 as being unpatentable over Sparks and Chau, and further in view of U.S. Patent No. 5,656,123 to Salimian et al. Claim 21 stands rejected under 35 U.S.C. §103 as being unpatentable over Sparks and Chau, and further in view of U.S. Patent 5,275,973 to Gelatos. Claim 22 stands rejected under 35 U.S.C. §103 as being unpatentable over Sparks and Chau, and further in view of U.S. Patent No. 5,747,353 to Bashir et al.

STATUS OF AMENDMENTS

No amendments were submitted after the Examiner's March 27, 2003 rejection.

SUMMARY OF INVENTION

The invention relates to micro-machining of materials to form structures such as sensors. The problem with prior micro-machining approaches relates to electrically connecting certain device portions which are suspended in relation to the remainder of the device. Those suspended portions typically prevent electrical conductors from passing through that region of the device. See page 1, lines 7-14.

One example device where this problem is found is a micro-machined, vibratory-ring gyroscope having freely-suspended tracks, as schematically depicted in the scanning electron micrograph of Figure 1. A ring 10 is fabricated and suspended in a silicon wafer substrate 8. The ring is suspended by eight ligament pairs (a-h) which connect the ring 10 and the substrate 8. Two freely-suspended tracks are shown at AA and BB in Figure 1. Track AA passes over a channel 4, and track BB bridges a device-suspended portion

14.

A process for fabricating these tracks is shown in Figures 3a-3d reproduced here in annotated form for the Board's convenience.

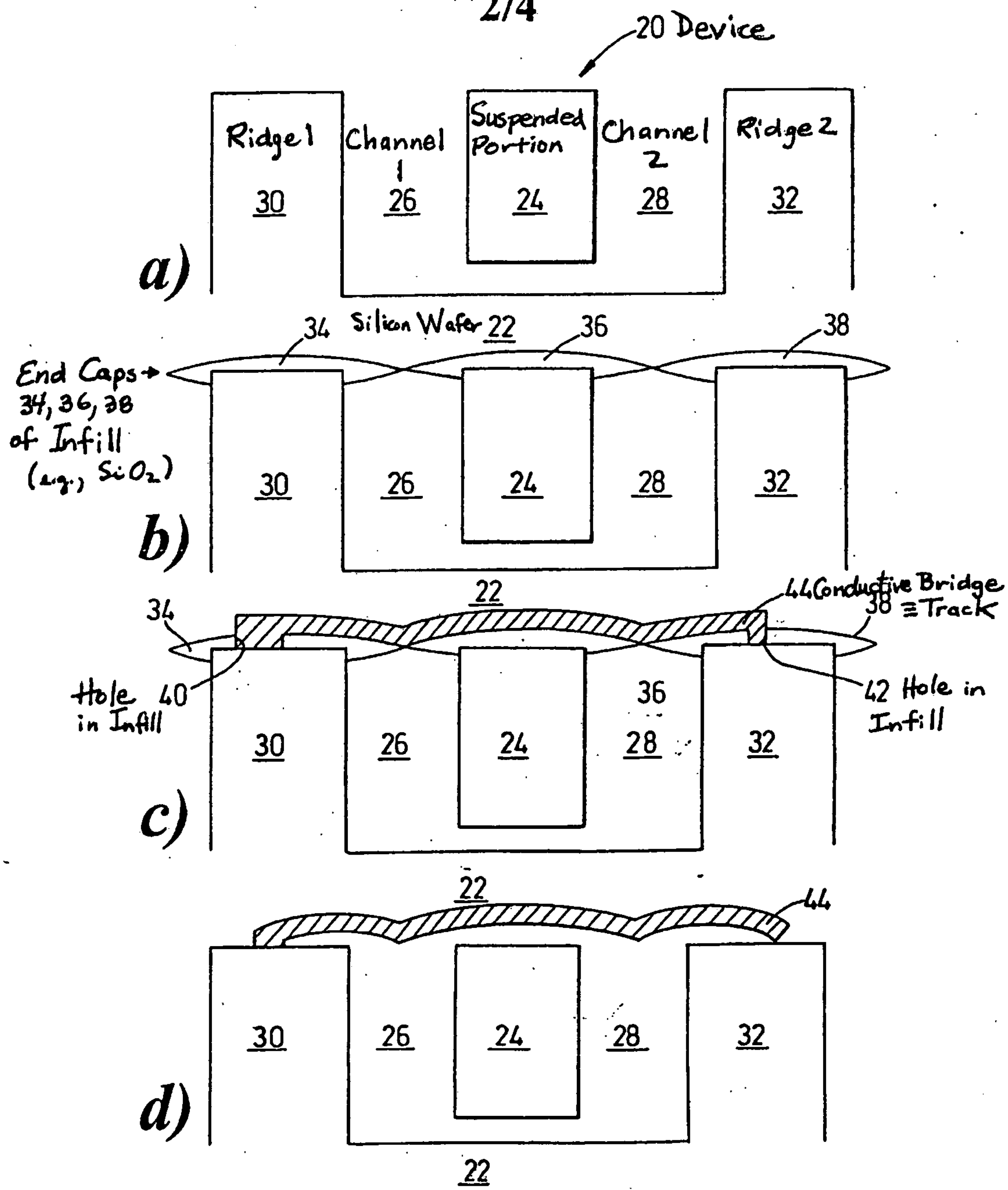
20 Device
Ridge 1
Channel 1
Suspended Portion
Channel 2
Ridge 2
30
26
24
28
32
a)
34
Silicon Wafer 22
36
38
End Caps → 34, 36, 38 of Infill (e.g., SiO_2)
b)
22
34
44 Conductive Bridge ≡ Track
38
Hole in Infill 40
36
42 Hole in Infill
c)
22
44
d)
22

Fig. 3

Figure 3a shows a cross section through a device 20 fabricated on a silicon wafer 22. A device portion 24 is suspended substantially free from the device 20 via a supporting ligament (not shown). Two channels 26 and 28 separate a suspended portion 24 from ridges 30 and 32 formed in a surface portion of the silicon wafer 22.

Figure 3b shows end caps 34, 36, and 38 of infill material created on the tops of the two ridges and the suspended portion. The end caps may be formed using a plasma-enhanced chemical vapor deposition process. The deposited material does not reach the bottom of the channels 26 and 28, but instead collects at the top portions 30, 24, and 32. The deposited infill material spreads laterally across the channels 26 and 28 until neighboring end caps meet at about the center of each channel 26 and 28 to seal the channels. As shown in Figure 3, those channels are only partially filled with the infill material, which in this example may be SiO_2.

The infill material is patterned and etched to create holes 40 and 42 in the infill material where it is desired to physically and electrically contact the silicon wafer 22. A conductive material is then deposited onto the infill material and etched to form a track of desired shape and dimension, such as the example track shown at 44 in Figure 3c. The track material 44 makes electrical and physical contact with the top portions of the silicon wafers 30 and 32, but does not physically or electrically contact the suspended portion 24. Thus, track 44 bridges the channels 26 and 28 and the suspended device portion 24 without having to physically or electrically make direct contact with the suspended portion 24.

ISSUES

• **Combination of Features.** An obviousness rejection must demonstrate where every feature of the rejected claims is disclosed or suggested in the applied prior art references. Independent claims 1 and 23 each requires a combination of method step features. Do the combined teachings of Sparks and Chau teach all of these claimed features?

• **Hindsight.** Obviousness requires that there be an objective teaching or suggestion from the prior art that would lead one of ordinary skill in the art to combine the teachings of multiple references. The Examiner makes multiple reference combinations. Is the motivation to combine these references in each combination a hindsight attempt to reconstruct the claims?

GROUPING OF CLAIMS

Claims 1-22 stand together. Claim 23 stands alone.

ARGUMENT

A. Sparks and Chau Do Not Disclose Claims 1 and 23

Sparks discloses a method for micro-machining the surface of a silicon substrate. The Examiner relies on Sparks' Figures 9a-9d and the accompanying description in column 12. An element 18 to be suspended is immobilized in the cavity 22 by a polyimide layer 48. That polyimide layer <u>completely</u> fills the cavity 22 in the substrate 20, as is shown in Figure 9a. A silicon nitride or a silicon dioxide film 50 is deposited to cover the polyimide layer 48 as shown in Figure 9b. Holes 52 are made in the silicon nitride film 50 to expose the polyimide layer 48 and to permit removal thereof. A second

silicon nitride film 54 is applied to plug or cover the openings 52 in the first silicon nitride film 50 and to encapsulate the micro-machined element 18. The polyimide layer 48 is completely removed. See column 9, lines 49-50. At this point, as indicated by the four arrow heads in Figures 9c and 9d, the element 18 can move within the enclosure. See column 9, lines 52-54.

Spark fails to disclose "partially filling and completely covering said channel with an infill material at an upper most region of said channel," as recited in claim 1. The Examiner contends that the word "completely" means both "completely" and "partially." This can not be the case. These words have different meanings. Moreover, a person of ordinary skill in the art, upon studying Sparks' Figs. 9a-9d and the related text, would understand that the polyimide material 48 completely fills the cavity or channel 22. That channel is defined on one side by the suspended element 18 and on the other side by the substrate 10. Because the suspended element 18 defines the channel, it can not be reasonably viewed as filling the channel. The Examiner does not rely on Chau to overcome this deficiency in Sparks. Lacking this feature from claim 1, the rejection of claim 1 and its dependent claims 2-22 is improper and should be withdrawn.

Sparks also fails to disclose "patterning and etching said infill material to form a hole through the infill material to the second material," recited in both claims 1 and 23. The Examiner admits this deficiency in Sparks at paragraph 21, on page 4 of the final Office Action. The Examiner attempts to remedy this admitted deficiency with Chau.

Chau discloses a method for fabricating a microstructure using temporary bridges.

The Examiner relies on the text at column 1, lines 24-46 where Chau describes a sacrificial oxide spacer layer deposited on a substrate surface. Holes are formed in the sacrificial spacer down to the substrate. A thin film microstructure material, like polysilicon, is deposited to fill in the holes and forms an uniform layer over the sacrificial layer. After patterning the microstructure material into a desired shape, the sacrificial layer is removed leaving a microstructure suspended above the substrate by the microstructure "anchors" formed using the sacrificial layer holes.

Chau does not remedy Spark's deficiencies. First, there is no teaching in Chau's column 1 of "at least partially filling said channel with an infill material at an uppermost region of said channel" (quoted from claim 23). Chau's text does not even describe a channel. There is nothing suspended over a channel. Chau simply describes making a bridge over a flat-surfaced substrate, which is not the same thing as creating a bridge <u>over a channel</u> in the substrate.

Second, Chau's sacrificial spacer layer is not "infill material" because it does not fill any channel. It is simply a spacer layer formed on the flat surface of the substrate. The Chau text certainly does not disclose <u>infilling</u> an "<u>uppermost</u> region of said <u>channel</u>."

Third, the spacer layer does not <u>partially</u> fill a channel or partially fill the upper channel region as required by claim 1. The whole point of having the partial infill material in an uppermost region of the channel in claim 1 is to be able to support the bridge over that channel. Chau does not need to create that support because there is no channel.

Neither step (b) nor (c) in claims 1 and 23 is described by the Chau text. There is no infill material in Chau in which to pattern or etch a hole. No bridge material is deposited in Chau on infill material. Because the patterning, etching, and depositing are performed on something other than infill material used to partially fill (claim 1) or perhaps completely fill (claim 23) a channel, Chau fails to overcome Sparks' deficiencies.

B. The Sparks-Chau Combination Is Improper

The Examiner's rationale for combining Chau's teachings with Sparks is flawed. The Examiner argues it would have been obvious "to have provided a method step for patterning and etching a sacrificial layer and subsequently depositing microstructure material in Sparks et al. in order to fill holes in which anchors for supporting a microstructure can be formed as taught by Chau et al." It is impermissible within the framework of §103 to pick and choose from any one reference only so much as will support the Examiner's position to the inclusion of other parts necessary to full appreciation of what such reference fairly suggests to one of ordinary skill in the art. *In re Hedges,* 783 F.2d 1038 (Fed. Cir 1986).

To use Chau's teachings in Sparks requires that an extra, sacrificial oxide spacer layer be formed on Sparks' infill material 48 in order to form holes in the infill material 48. That additional step militates against the combination proposed by the Examiner.

The microstructure 18 in Sparks is not supported, as is clearly shown in Figures 9c-9d. Column 12, lines 49-54 also explains that micromachined element 18 freely moves within the cavity. In contrast, Chau's micromachined element—the

microstructure—is <u>fixedly</u> suspended <u>over</u> the substrate (not within a cavity in the substrate) by the anchors. Chau explains "leaving behind a microstructure suspended above the substrate by the anchors." Column 1, lines 45-46. Fixedly supporting a microstructure in Sparks defeats the whole purpose of Sparks' process described in column 12 and illustrated in Figures 9a-9d to achieve a freely-movable machined element 18 within the cavity 22. There is no cavity or channel Chau's substrate in which a micromachined element can move freely! Chau does not ever describe the microstructure moving in the column 1 text.

The Federal Circuit has found that where a required modification renders some part of a reference inoperable for an intended purpose, there is a teaching away from rather than a suggestion supporting the modification. *In re Gordon* 733 F.2d 900 (Fed. Cir. 1984). The Examiner's modification means that Sparks' element 18 cannot move freely in the sealed cavity 22 as Sparks intended. The modification is improper.

As demonstrated above, the rejection is improper because the combination of Sparks and Chau does not comply with the legal requirements for making an obviousness combination. The Examiner's combination requires an (1) extra step, (2) picking and choosing only parts of Chau while ignoring other parts, and (3) changing Sparks so that the element 18 ends up being fixedly set over the cavity 22 rather than freely movable with the cavity 22. Given these three deterrents, the only motivation to combine Sparks and Chau is Appellant's own disclosure. That motivation is not permitted. *Sensonics, Inc. v. Aerosonic Corp.*, 81 F.3d 1566, 1570 (Fed. Cir. 1996).

CONCLUSION

Sparks and Chau do not teach the features of independent claims 1 and 23. Nor is the proposed modification of Sparks with Chau proper. Each ground alone requires the Board to reverse the outstanding final rejection and pass this case to allowance.

Respectfully submitted,

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Claims on Appeal

USSN 09/786,813 (124-847)

1. A micro-machining method of bridging a channel with at least one bridging material, the channel being provided in a substrate comprising a second material and the method comprising the steps of:

a) partially filling and completely covering said channel with an infill material at an uppermost region of said channel;

b) patterning and etching said infill material to form a hole through the infill material to the second material; and

c) depositing the at least one bridging material on to said infill material so that at least one portion of the at least one bridging material contacts the second material through the hole.

2. A method according to claim 1 comprising removing the infill material once the at least one bridging material has been provided leaving the at least one bridging material bridging said channel.

3. A method according to claim 2 comprising providing at least a portion of the at least one bridging material which is freely suspended above the second material.

4. A method according to claim 3 comprising micro-machining structures from a second material and creating at least one device suspended portion, which is substantially free from the bulk of the second material and providing at least one channel separating the device suspended portion from the bulk of the second material and providing the freely suspended portion of the at least one bridging material extending over the channel.

5. A method according to claim 4 comprising performing a sacrificial etch to release the device suspended portion from the bulk of the second material before the infill material is provided.

6. A method according to claim 4 or 5 comprising creating the freely suspended portion of the at least one bridging material extending over the device suspended portion.

7. A method according to claim 4 comprising performing a sacrificial etch to release the device suspended portion from the bulk of the substrate after the infill material is provided.

8. A method according to claim 7 in which the at least one bridging material is not substantially etched by the sacrificial etch.

9. A method according to claim 1 comprising depositing a conductive material as the at least one bridging material.

10. A method according to claim 1 wherein a plurality of bridging materials are used to bridge the channel.

11. A method according to claim 10 comprising providing a supporting layer and one or more conductive layers within the bridge over the channel.

12. A method according to claim 1 which comprises depositing the infill material using Plasma Enhanced Chemical Vapour Deposition (PECVD).

13. A method according to claim 1 which comprises depositing one of the following materials as the infill layer: an oxide, a nitride, an oxynitride, polysilicon.

14. A method according to claim 1 which comprises using a dual frequency PECVD system to deposit the infill material wherein the plasma is generated at a first frequency and species accelerated toward the second material at a second frequency.

15. A method according to claim 1 which causes the infill material to expand laterally across the channel

16. A method according to claim 1 comprising causing the deposited material to cap the channel sealing the channel at the top region.

17. A method according to claim 2 which comprises using an etching process to remove the infill material.

18. A method according to claim 4 which comprises using any one of the following for the infill material: a polymer material, a polyimide, a photoresist, PIQ™, spin on glass, or other spin on di-electric.

19. A method according to claim 18 which comprises flowing the infill material so that it flows into the channel.

20. A method according to claim 18 which comprises using a dry etching process to remove the infill material.

21. A method according to claim 1 which comprises using a photoresist as the infill material and further comprises using a mask to develop the photoresist and then etching the mask to remove portions of photoresist.

22. A method according to claim 1 which comprises using a polyimide as the infill material and subsequently applying a photoresist on top of the infill material to allow the infill material to be patterned and etched.

23. A micro-machining method of bridging a channel with at least one bridging material, the channel being provided in a substrate comprising a second material and the method comprising the steps of:

a) at least partially filling said channel with an infill material at an uppermost region of said channel;

b) patterning and etching said infill material to form a hole through the infill material to the second material; and

depositing the at least one bridging material on to said infill material so that at least one portion of the at least one bridging material contacts the second material through the hole.